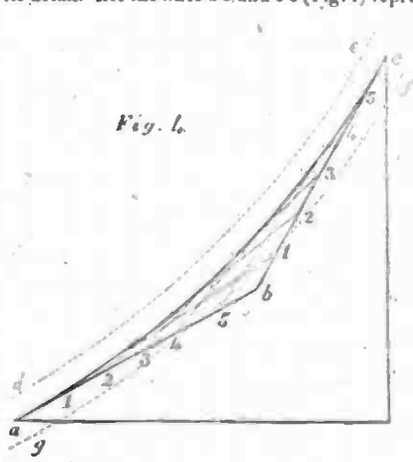
cylinder. A spiral line, is a line drawn upon the surface of the cylinder at any angle of inclination which might be required. and the development of a spiral line upon a plain surface would represent the hypothenuse of a right-angled triangle. Thus let A B C (Fig. 3) represent the base of a semi-cylinder, and the figure D E F G its elevation. The development of the cylindric surface upon the line A C B will be a parallelogram whose base line H I is equal in length to the circle A C B, and whose height H K is equal to the height E G of the cylinder. In the development, the hypothenusal line H L will form the development of the spiral line F E upon the surface of the cylinder. The projection of a spiral line upon the elevational surface of the cylinder may be performed by dividing the circle A C B into any number of equal parts as indicated by the points *a a a*, &c. Having transferred these divisions to the base line H I of the development as shewn by the points *b b b*, &c., draw the vertical lines *bf*, *bf*, &c., cutting the development of the spiral line K I in the points *f f f*, &c. upon the elevational surface of the cylinder, and from the points *a a a*, &c., on the plan of its base, draw the vertical lines *ag*, *ag*, &c., intersecting the horizontal lines *fg*, *fg*, &c., in the points *g g*, and through which trace the line F E, which is the projection of the spiral line winding round the surface of the cylinder as developed by the line H L.

11. On reverting again to the hollow cylinder, which we have already mentioned, as formed of wood, upon both surfaces of which we shall suppose the student to have marked off the arrises of the upper and the lower surfaces of the quadrilateral solid, it will be observed that any straight line taken at right angles to the axial line of the cylinder will coincide with any radiating line upon the upper or the lower surfaces of the solid respectively; but as the inner and the outer arrises of these inclined surfaces are ranging at different angles of inclination, it therefore follows that the mean inclination of either the upper or the lower surface between their respective arrises is in a central line between the two arrises respectively, and the true development of this line would be the hypothenuse of a triangle in the developed surface of a cylinder whose radius is equal to the distance from the centre of the cylinder to the central line of the quadrilateral solid.

12. If, however, as is generally the case, where this quadrilateral solid, which constitutes the handrail round the cylindric ends of the well-hole, is joined by the straight portions of the rail connected with the flyers, and which are ranging at an angle of inclination different from that round the cylinder. The junction of the inclinations of both will to avoid deformity, require to be eased of by a curved line.

13. The simple and beautiful outline of the parabolic curve is the best adapted to this purpose; it is already well known, from its having been in use for more than a century. Our article, however, requires us here to enter into its detail. Let the lines *a b* and *b c* (Fig. 4) repre-

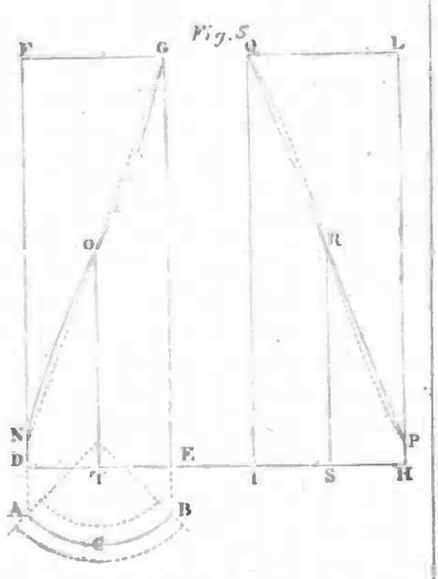


sent the intersection of the two inclined surfaces of the rail; let *a* and *c* represent the points at which the curve is to commence; divide the lines *a b* and *b c* each into any number of equal parts 1 2 3 4, &c.; which being done, draw lines from the points marked 1 2 3, &c. in the lines *a b* to the corresponding points 1 2 3, &c. in the line *b c*; and from the intersection of these lines the curve may be adjusted by the hand to the greatest accuracy. The dotted lines *d e* and *f g* represent the upper and lower arrises of the rail, from the different curvatures of which it will be observed that the upper and the lower surfaces of the rail are not in the same angle of inclination; therefore, the mean between both surfaces, as shewn by the line *a c*, will be the correct inclination of the rail.

14. We are, therefore, not only as regards the diameter of our cylinder, on the surface of which we shall conceive our line of heights to be placed, but also in the development of the line of heights, to confine ourselves to those dimensions which pertain to the centre of the rail only.

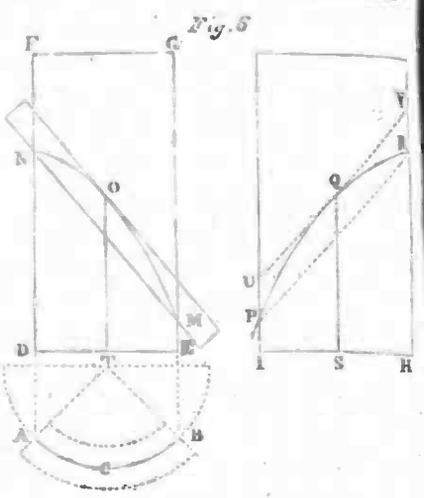
15. By the line of heights is meant the inclination of the handrail, as laid down upon the developed surface of the cylinder. Its use is to enable us to ascertain the correct height or position of our cutting-plane in the cylinder, as we shall hereafter treat more at large.

16. If we divide the length of our quadrilateral solid into parts not exceeding one-fourth of a revolution round the cylinder, we shall find that the proximity between the line or arris produced by winding the development of the line of heights round the surface of the cylinder, and that produced on the same surface by the intersection of a cutting-plane made to pass through any three points approximating nearest to the general line of heights, is such as will enable us to ascertain with certainty in what position the plane of our face-mould should cut through the cylinder. Thus, let the circle A C B (Fig. 5) represent a portion of the base



of a cylinder, and the lines D E F G its elevation; also let the parallelogram H I Q L represent the development of the cylindric surface, and the line P Q the line of heights; suppose then that the lower portion of the development of the cylindric surface up to the line P Q is wrapped round the cylinder, we should find the perpendicular heights H P, R S, and I Q in the development to coincide with the perpendicular heights D N, T O, and E G on the cylindric surface respectively; but the straight line P R Q would produce the spiral line on the elevation of the surface of the cylinder. And, moreover, as the cutting-plane for our face-mould would, in passing through the cylinder, as shewn by the dotted line N O G, cannot in this case be made to pass through the entire spiral line, it is sufficient for our purpose if it be made to pass through the nearest approximating points, N O G, as shewn in the diagram.

17. Again, if, as in Fig. 6, where the line of heights P Q R in the development is represented on the surface of the cylinder by the curved spiral line N O M, our cutting plane in such a case would not only be required to pass through the straight line N M, but its direction from thence should also be made to pass the point O on the cylindric surface. This intermediate point O is first to be determined on the development by drawing the tangent line U V parallel to the line P R, but touching the curved line of heights in the point Q, which



being transferred to the surface of the cylinder, as seen in the point O, we have then obtained three points, N O M, on the surface of the cylinder through which our section is to pass. The theory for determining the relative position of this plane, with a vertical plane passing through the axial line of the entire cylinder, so as to obtain the *contour* of the face-mould, and the bevils for its application to the surfaces of the plank, depends on the properties of the trihedral and its solid angles, which we shall next enter upon previous to our delineation of the various details connected with this branch of science.

(To be continued.)

SLIP OF CHALK AT EAST CLIFF, DOVER.

EVERY observer of the cliffs of Dover will behold the same weather-beaten face that terrified the army of Cæsar, with very little alteration, in this locality, till you come some fifty or seventy yards beyond the Jetty. The same flints, had they eyes, would have seen the glorious lord of day rise for the last 2,000 years. The builder of certain premises on the cliff, from an error in judgment, and following the example of others, continued the line of buildings, not observing or regarding the mound of loose chalk thrown down when the moat round the castle was enlarged; and, finding the foot or bottom in his way, removed it. Consequently, the late heavy and incessant rains, lodging on the top or table, so saturated it, that the part above slipped, and filled up the space which he had made, and on which a part of the building stood. I have been an accurate observer of the cliffs for half a century. There never has been, properly so called, a fall of the cliffs in that time, but virtual slips have been occasioned by the sea washing away the bottom, or by some excavations of man at the foot; otherwise the cliff cannot slip (or fall, if you please), but from one or other of these joint causes. I call the attention of the scientific, or my contemporary observers, as well to the present slip as to the different ones along the railroad—the great one at Shakspeare's Cliff in 1800, or thereabout, and the one on the 12th of November, 1810, when the pig that survived for months under the ruins was buried. Here not only was the foot of the cliff cut away, but a piece of ordnance was placed immediately above, the plane and mounds of which retained the rains, and occasioned the slip. It will be found universally that a greater quantity of earth or loose soil is found at the top of all slips of chalk that retain the rains, which, by the joint action of gravity and the attraction of the sun, descend on inclined planes which they form; and if that inclined plane reaches the face of the cliff before it gets to the base, there, and there only, can a slip of our far-famed cliffs happen. I consider all the houses in the locality of East Cliff, facing the sea, as safe as Snargate-street; for it would require a great projectile force to send from the apex of the cliffs any portion thereof. The nine tons of gunpowder, used at the great blast at Roundown, did not project farther. I am informed that a Government survey has been made, and that it is their intention to remove the objectionable points, and then every part of that locality will be safe.—*Dover Chronicle.*

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